

THE CLAIMS

What Is Claimed Is:

- 5 1. A bone graft material, which have a cell adhesion-inducing peptide and/or tissue growth factor-derived peptide immobilized on the surface.
2. The bone graft material according to claim 1, wherein the cell adhesion-inducing peptide has an amino acid sequence of RGD.
- 10 3. The bone graft material according to claim 2, wherein the cell adhesion-inducing peptide has an amino acid sequence of CGGRGDS (SEQ ID NO: 1) or CGGVACDCRGDCFC (SEQ ID NO: 2).
- 15 4. The bone graft material according to claim 1, wherein the tissue growth factor-derived peptide is at least one peptide selected from the group consisting of the following peptides:
 - (a) the amino acid sequence at positions 2-18 of each of bone morphogenetic proteins (BMP)-2, 4 and 6 [SEQ ID NO: 3 for BMP-2, SEQ ID
 - 20 NO: 4 for BMP-4, and SEQ ID NO: 5 for BMP-6]; the amino acid sequence at positions 16-34 of BMP-2 (SEQ ID NO: 6), the amino acid sequence at positions 47-71 (SEQ ID NO: 7), the amino acid sequence at positions 73-92 (SEQ ID NO: 8), the amino acid sequence at positions 88-105 (SEQ ID NO: 9), the amino acid sequence at positions 283-302 (SEQ ID NO: 10), the amino
 - 25 acid sequence at positions 335-353 (SEQ ID NO: 11) and the amino acid sequence at positions 370-390 (SEQ ID NO: 12); the amino acid sequence at positions 74-93 of BMP-4 (SEQ ID NO: 13), the amino acid sequence at positions 293-313 (SEQ ID NO: 14), the amino acid sequence at positions 360-379 (SEQ ID NO: 15) and the amino acid sequence at positions 382-402 (SEQ
 - 30 ID NO: 16); the amino acid sequence at positions 91-110 of BMP-6 (SEQ ID

NO: 17), the amino acid sequence at positions 397-418 (SEQ ID NO: 18), the amino acid sequence at positions 472-490 (SEQ ID NO: 19) and the amino acid sequence at positions 487-510 (SEQ ID NO: 20); and the amino acid sequence at positions 98-117 of BMP-7 (SEQ ID NO: 21), the amino acid
5 sequence at positions 320-340 (SEQ ID NO: 22), the amino acid sequence at positions 390-409 (SEQ ID NO: 23) and the amino acid sequence at positions 405-423 (SEQ ID NO: 24);

(b) the amino acid sequence at positions 62-69 of bone sialoprotein (SEQ ID NO: 25), the amino acid sequence at positions 139-148 (SEQ ID NO: 26), the amino acid sequence at positions 259-277 (SEQ ID NO: 27), the amino acid sequence at positions 199-204 (SEQ ID NO: 28), the amino acid sequence at positions 151-158 (SEQ ID NO: 29), the amino acid sequence at positions 275-291 (SEQ ID NO: 30), the amino acid sequence at positions 20-28 (SEQ ID NO: 31), the amino acid sequence at positions 65-90 (SEQ ID NO: 32), the amino acid sequence at positions 150-170 (SEQ ID NO: 33) and the amino acid sequence at positions 280-290 (SEQ ID NO: 34);
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(c) the amino acid sequence at positions 242-250 of a transforming growth factor (SEQ ID NO: 35), the amino acid sequence at positions 279-299 (SEQ ID NO: 36) and the amino acid sequence at positions 343-361 (SEQ ID NO: 37);
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(d) the amino acid sequence at positions 100-120 of a platelet-derived growth factor (SEQ ID NO: 37) and the amino acid sequence at positions 121-140 (SEQ ID NO: 39);

(e) the amino acid sequence at positions 23-31 of an acidic fibroblast growth factor (SEQ ID NO: 40) and the amino acid sequence at positions 97-105 (SEQ ID NO: 41);
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(f) the amino acid sequence at positions 16-27 of a basic fibroblast growth factor (SEQ ID NO: 42), the amino acid sequence at positions 37-42 (SEQ ID NO: 43), the amino acid sequence at positions 78-84 (SEQ ID NO: 44) and the amino acid sequence at positions 107-112 (SEQ ID NO: 45);
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(g) the amino acid sequence at positions 255-275 of dentin sialoprotein (SEQ ID NO: 46), the amino acid sequence at positions 475-494 (SEQ ID NO: 47) and the amino acid sequence at positions 551-573 (SEQ ID NO: 48);

(h) the amino acid sequence at positions 63-83 of a heparin binding EGF-like growth factor (SEQ ID NO: 49), the amino acid sequence at positions 84-103 (SEQ ID NO: 50), the amino acid sequence at positions 104-116 (SEQ ID NO: 51) and the amino acid sequence at positions 121-140 (SEQ ID NO: 52);

(i) the amino acid sequence at positions 326-350 of the cadherin EGF LAG seven-pass G-type receptor 3 (SEQ ID NO: 53), the amino acid sequence at positions 351-371 (SEQ ID NO: 54), the amino acid sequence at positions 372-400 (SEQ ID NO: 55), the amino acid sequence at positions 401-423 (SEQ ID NO: 56), the amino acid sequence at positions 434-545 (SEQ ID NO: 57), the amino acid sequence at positions 546-651 (SEQ ID NO: 58), the amino acid sequence at positions 1375-1433 (SEQ ID NO: 59), the amino acid sequence at positions 1435-1471 (SEQ ID NO: 60), the amino acid sequence at positions 1475-1514 (SEQ ID NO: 61), the amino acid sequence at positions 1515-1719 (SEQ ID NO: 62), the amino acid sequence at positions 1764-1944 (SEQ ID NO: 63) and the amino acid sequence at positions 2096-2529 (SEQ ID NO: 64); and

(j) the amino acid sequence at positions 54-159 of an osteoblast specific cadherin (OB-cadherin) (SEQ ID NO: 65), the amino acid sequence at positions 160-268 (SEQ ID NO: 66), the amino acid sequence at positions 269-383 (SEQ ID NO: 67), the amino acid sequence at positions 384-486 (SEQ ID NO: 68) and the amino acid sequence at positions 487-612 (SEQ ID NO: 69).

5. The bone graft material according to claim 4, wherein the tissue growth factor-derived peptide has an addition of cysteine at N-terminal end.

30 6. The bone graft material according to claim 5, wherein the addition of

cysteine is CGG spacer type.

7. The bone graft material according to any one claim among claims 1-6, wherein the bone graft material is any one selected from the group consisting of organism-derived bone mineral powders and porous blocks originated from autogeneous bone, bovine bone and porcine bone, synthetic hydroxyapatite powders and porous blocks, tricalcium phosphate powders and porous blocks, monocalcium phosphate powders and porous blocks, bone graft materials made of silicon dioxide (silica), bone-packing graft materials made of a mixture of silica and polymer, fine particles and porous scaffolds made of biocompatible polymers, including chitosan and polylactic acid, and titanium and three-dimensional scaffolds.

8. The bone graft material according to claim 5, wherein the surface of the bone graft material is immobilized with a crosslinker.

9. The bone graft material according to claim 8, wherein the crosslinker is any one or more selected from the group consisting of 1,4-bis-maleimidobutane (BMB), 1,11-bis-maleimido tetraethyleneglycol (BM[PEO]₄), 1-ethyl-3-[3-dimethyl aminopropyl] carbodiimide hydrochloride (EDC), succinimidyl-4-[N-maleimido methylcyclohexane-1-carboxy-[6-amidocaproate]] (SMCC) and sulfo-SMCC, succinimidyl 6-[3-(2-pyridyldithio)ropionamido] hexanoate] (SPDP) and sulfo-SPDP, m-maleimidobenzoyl-N-hydroxysuccinimide ester (MBS) and sulfo-MBS, succinimidyl [4-(p-maleimidophenyl) butyrate] (SMPB) and sulfo-SMPB.

10. A scaffold for tissue engineering applications, which have a cell adhesion-inducing peptide and/or tissue growth factor-derived peptide immobilized on the surface.

11. The scaffold for tissue engineering applications according to claim 10, wherein the cell adhesion-inducing peptide has an amino acid sequence of RGD.

5 12. The scaffold for tissue engineering applications according to claim 11, wherein the cell adhesion-inducing peptide has an amino acid sequence of CGGRGDS (SEQ ID NO: 1) or CGGVACDCRGDCFC (SEQ ID NO: 2).

13. The scaffold for tissue engineering applications according to claim 10, wherein the tissue growth factor-derived peptide is at least one peptide selected from the group consisting of the following peptides:

(a) the amino acid sequence at positions 2-18 of each of bone morphogenetic proteins (BMP)-2, 4 and 6 [SEQ ID NO: 3 for BMP-2, SEQ ID NO: 4 for BMP-4, and SEQ ID NO: 5 for BMP-6]; the amino acid sequence at positions 16-34 of BMP-2 (SEQ ID NO: 6), the amino acid sequence at positions 47-71 (SEQ ID NO: 7), the amino acid sequence at positions 73-92 (SEQ ID NO: 8), the amino acid sequence at positions 88-105 (SEQ ID NO: 9), the amino acid sequence at positions 283-302 (SEQ ID NO: 10), the amino acid sequence at positions 335-353 (SEQ ID NO: 11) and the amino acid sequence at positions 370-390 (SEQ ID NO: 12); the amino acid sequence at positions 74-93 of BMP-4 (SEQ ID NO: 13), the amino acid sequence at positions 293-313 (SEQ ID NO: 14), the amino acid sequence at positions 360-379 (SEQ ID NO: 15) and the amino acid sequence at positions 382-402 (SEQ ID NO: 16); the amino acid sequence at positions 91-110 of BMP-6 (SEQ ID NO: 17), the amino acid sequence at positions 397-418 (SEQ ID NO: 18), the amino acid sequence at positions 472-490 (SEQ ID NO: 19) and the amino acid sequence at positions 487-510 (SEQ ID NO: 20); and the amino acid sequence at positions 98-117 of BMP-7 (SEQ ID NO: 21), the amino acid sequence at positions 320-340 (SEQ ID NO: 22), the amino acid sequence at positions 390-409 (SEQ ID NO: 23) and the amino acid sequence at positions

405-423 (SEQ ID NO: 24);

(b) the amino acid sequence at positions 62-69 of bone sialoprotein (SEQ ID NO: 25), the amino acid sequence at positions 139-148 (SEQ ID NO: 26), the amino acid sequence at positions 259-277 (SEQ ID NO: 27), the amino acid sequence at positions 199-204 (SEQ ID NO: 28), the amino acid sequence at positions 151-158 (SEQ ID NO: 29), the amino acid sequence at positions 275-291 (SEQ ID NO: 30), the amino acid sequence at positions 20-28 (SEQ ID NO: 31), the amino acid sequence at positions 65-90 (SEQ ID NO: 32), the amino acid sequence at positions 150-170 (SEQ ID NO: 33) and the amino acid sequence at positions 280-290 (SEQ ID NO: 34);

(c) the amino acid sequence at positions 242-250 of a transforming growth factor (SEQ ID NO: 35), the amino acid sequence at positions 279-299 (SEQ ID NO: 36) and the amino acid sequence at positions 343-361 (SEQ ID NO: 37);

(d) the amino acid sequence at positions 100-120 of a platelet-derived growth factor (SEQ ID NO: 37) and the amino acid sequence at positions 121-140 (SEQ ID NO: 39);

(e) the amino acid sequence at positions 23-31 of an acidic fibroblast growth factor (SEQ ID NO: 40) and the amino acid sequence at positions 97-105 (SEQ ID NO: 41);

(f) the amino acid sequence at positions 16-27 of a basic fibroblast growth factor (SEQ ID NO: 42), the amino acid sequence at positions 37-42 (SEQ ID NO: 43), the amino acid sequence at positions 78-84 (SEQ ID NO: 44) and the amino acid sequence at positions 107-112 (SEQ ID NO: 45);

(g) the amino acid sequence at positions 255-275 of dentin sialoprotein (SEQ ID NO: 46), the amino acid sequence at positions 475-494 (SEQ ID NO: 47) and the amino acid sequence at positions 551-573 (SEQ ID NO: 48);

(h) the amino acid sequence at positions 63-83 of a heparin binding EGF-like growth factor (SEQ ID NO: 49), the amino acid sequence at positions 84-103 (SEQ ID NO: 50), the amino acid sequence at positions 104-116 (SEQ

ID NO: 51) and the amino acid sequence at positions 121-140 (SEQ ID NO: 52);

- (i) the amino acid sequence at positions 326-350 of the cadherin EGF LAG seven-pass G-type receptor 3 (SEQ ID NO: 53), the amino acid sequence at positions 351-371 (SEQ ID NO: 54), the amino acid sequence at positions 372-400 (SEQ ID NO: 55), the amino acid sequence at positions 401-423 (SEQ ID NO: 56), the amino acid sequence at positions 434-545 (SEQ ID NO: 57), the amino acid sequence at positions 546-651 (SEQ ID NO: 58), the amino acid sequence at positions 1375-1433 (SEQ ID NO: 59), the amino acid sequence at positions 1435-1471 (SEQ ID NO: 60), the amino acid sequence at positions 1475-1514 (SEQ ID NO: 61), the amino acid sequence at positions 1515-1719 (SEQ ID NO: 62), the amino acid sequence at positions 1764-1944 (SEQ ID NO: 63) and the amino acid sequence at positions 2096-2529 (SEQ ID NO: 64); and
- (j) the amino acid sequence at positions 54-159 of an osteoblast specific cadherin (OB-cadherin) (SEQ ID NO: 65), the amino acid sequence at positions 160-268 (SEQ ID NO: 66), the amino acid sequence at positions 269-383 (SEQ ID NO: 67), the amino acid sequence at positions 384-486 (SEQ ID NO: 68) and the amino acid sequence at positions 487-612 (SEQ ID NO: 69).

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14. The scaffold for tissue engineering applications according to claim 4, wherein the tissue growth factor-derived peptide has an addition of cysteine at N-terminal end.

- 25 15. The scaffold for tissue engineering applications according to claim 5, wherein the addition of cysteine is CGG spacer type.

16. The scaffold for tissue engineering applications according to any one claim among claims 10-15, wherein the bone graft material is any one selected from the group consisting of organism-derived bone mineral powders and
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porous blocks originated from autogeneous bone, bovine bone and porcine bone, synthetic hydroxyapatite powders and porous blocks, tricalcium phosphate powders and porous blocks, monocalcium phosphate powders and porous blocks, bone graft materials made of silicon dioxide (silica), bone-
5 packing graft materials made of a mixture of silica and polymer, fine particles and porous scaffolds made of biocompatible polymers, including chitosan and polylactic acid, and titanium and three-dimensional scaffolds.

17. The scaffold for tissue engineering applications according to claim 10,
10 wherein the scaffold for tissue engineering applications is a barrier membrane or an implant.

18. The scaffold for tissue engineering applications according to claim 17,
wherein the barrier membrane is porous membranes made of polylactic acid;
15 regeneraton membranes made of nanofibers of chitin or chitosan; or film-shaped barrier membranes made of chitin or chitosan.

19. The scaffold for tissue engineering applications according to claim 17,
wherein the implant is titanium implant.

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20. The scaffold for tissue engineering applications according to claim 17,
wherein the surface of the implants is modified by oxidation and nitrification
so as to facilitate the adhesion of the active peptide to the surface.

25 21. The scaffold for tissue engineering applications according to claim 10,
wherein the surface of the bone graft material is immobilized with a crosslinker.

22. The scaffold for tissue engineering applications according to claim 21,
wherein the crosslinker is any one or more selected from the group consisting
30 of 1,4-bis-maleimidobutane (BMB), 1,11-bis-maleimido tetraethyleneglycol

(BM[PEO]₄), 1-ethyl-3-[3-dimethyl aminopropyl] carbodiimide hydrochloride (EDC), succinimidyl-4-[N-maleimido methylcyclohexane-1-carboxy-[6-amidocaproate]] (SMCC) and sulfo-SMCC, succinimidyl 6-[3-(2-pyridyldithio)-ropionamido] hexanoate] (SPDP) and sulfo-SPDP), m-maleimidobenzoyl-N-
5 hydroxysuccinimide ester (MBS) and sulfo-MBS, succinimidyl [4-(p-maleimidophenyl) butyrate] (SMPB) and sulfo-SMPB.